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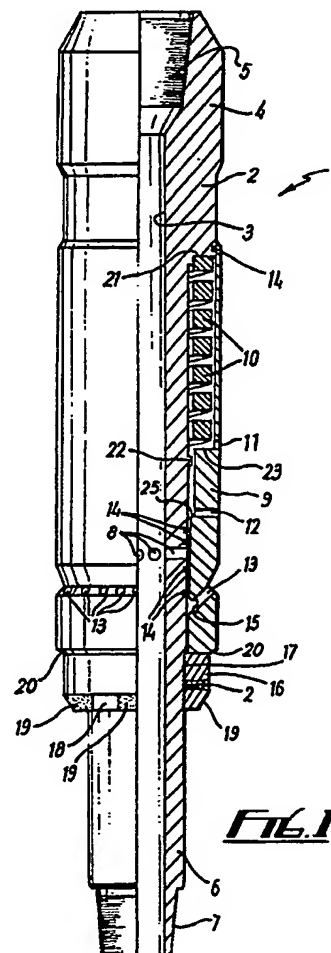
GB 0545271 A US 4637471 A US 4315542 A  
US 3907046 A

(58) Field of Search

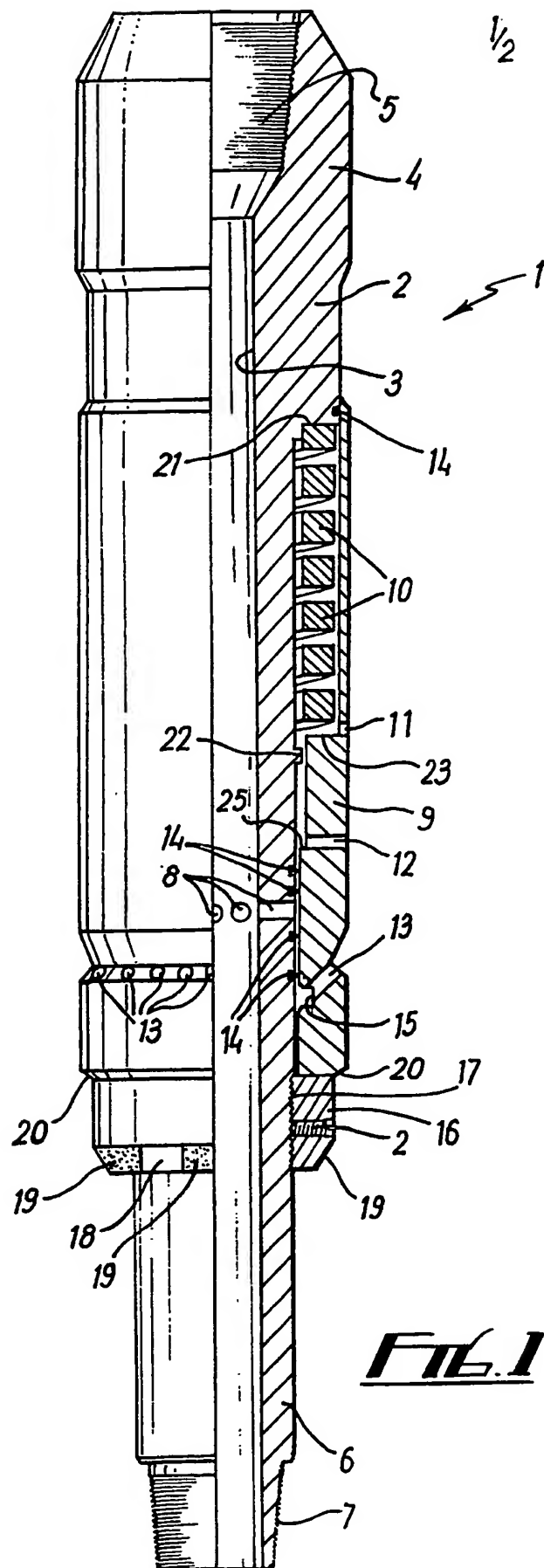
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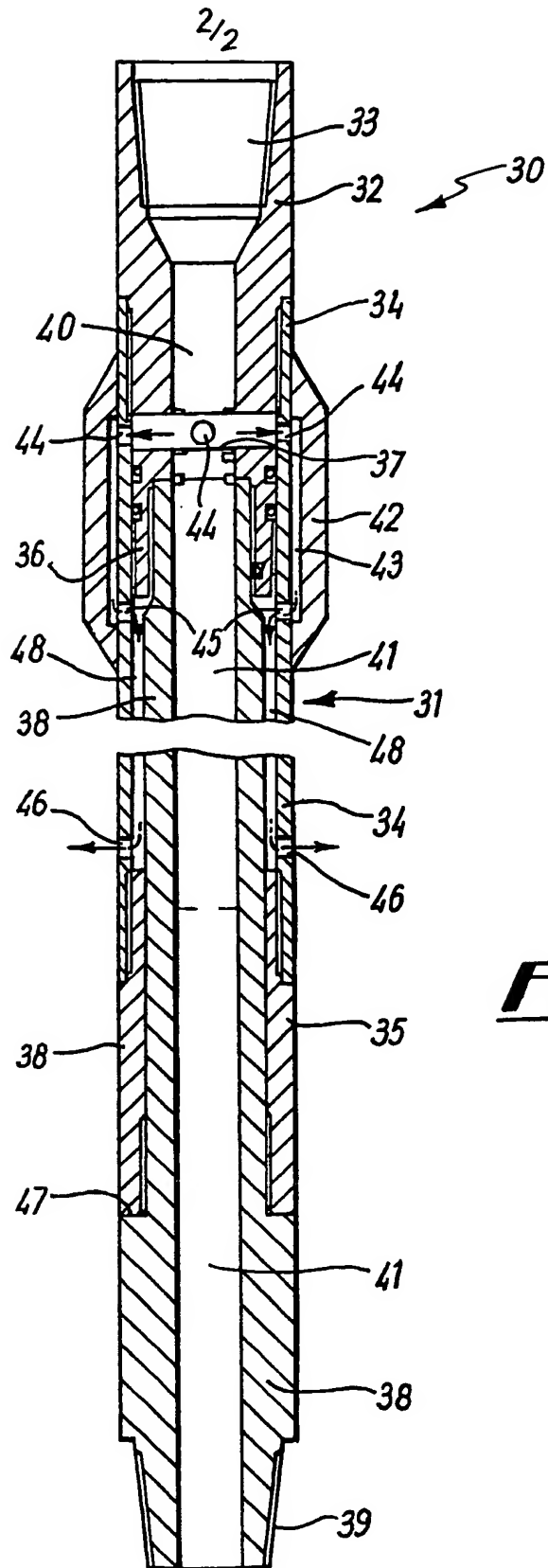
(54) Apparatus for circulating fluid

(57) Apparatus (1) for circulating fluid in a borehole comprises a body member (2) having a fluid outlet (8). An isolation sleeve (9) is movably mounted on the body member (2) for movement between an open position in which fluid may flow out of the outlet (8) and a closed position. The isolation sleeve (9) is moved to its open position against the action of spring 10 by engaging shoulder 20 with the top of the lining and setting down on the tubing string. In a second embodiment (not shown) the outlet is opened when the lower end of the tubing string engages the bottom of the borehole.



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**FIG. 2**

1     "Apparatus for Circulating Fluid"

2

3     The invention relates to apparatus for circulating  
4     fluid and in particular, apparatus for circulating  
5     fluid in a borehole.

6

7     It is common practice to install liners within a  
8     borehole which has been drilled and after installation  
9     of the liners it is generally necessary to clean out  
10    the inside of the liner to wash away any debris or  
11    other contaminants.

12

13    Generally, the liner is in the form of a cylindrical  
14    tube which has a relatively small internal diameter  
15    compared with the diameter of casing lining the  
16    borehole immediately above the liner. To effectively  
17    clean out inside the liner, high flow rates are  
18    generally required to create turbulence to aid the  
19    cleaning out process. Generally, the clean out  
20    procedure is carried out by first passing cleaning  
21    liquid through the drill string to the lower end of the  
22    liner at a high flow rate so that the cleaning fluid  
23    flows turbulently up the annulus between the inside of  
24    the liner and the outside of the drill-pipe and then  
25    into the casing above the liner.

26

1     However, because of the difference in volume between  
2     the liner and the casing above the liner, after the  
3     cleaning fluid passes the top of the liner and enters  
4     the relatively large volume of the casing, the flow  
5     rate of the cleaning fluid in the casing above the  
6     liner is greatly reduced and any cleaning action  
7     becomes negligible.

8  
9     Hence, it is generally necessary after passing cleaning  
10    fluid through the liner to then pass further cleaning  
11    fluid from the drill-pipe into the casing at a location  
12    above or adjacent the top edge of the liner, so that a  
13    high flow rate and hence turbulence of the cleaning  
14    fluid can be obtained in the casing. Therefore it is  
15    generally necessary to have some device at or adjacent  
16    to the top end of the liner which can be operated  
17    downhole to either circulate fluid through the length  
18    of the drill string to the lower end of the liner or  
19    which can direct cleaning fluid at high flow rates out  
20    of the drill string into the casing above the liner, at  
21    or adjacent the top edge of the liner.

22  
23    Once such device that is known for carrying out this  
24    operation comprises a hollow body member and in order  
25    to change the direction of flow between the bottom of  
26    the liner and the top edge of the liner, spherical  
27    balls are dropped down the drill-string to open or  
28    close valves in the device.

29  
30    However, there are a number of disadvantages associated  
31    with this apparatus. In particular, the length of time  
32    associated with the spherical balls falling from the  
33    surface to the device through a drill-string which is  
34    perhaps a few thousand feet in length can take 25 to 30  
35    minutes. Hence, there is a problem with co-ordinating

1 the arrival of the spherical ball at the apparatus to  
2 coincide with the arrival of the required cleaning  
3 fluid at the apparatus. It is also necessary to ensure  
4 that the increasing and decreasing flow rates  
5 associated with the liner and the casing clean out are  
6 co-ordinated with the arrival of the spherical ball at  
7 the apparatus.

8  
9 In addition, it is generally necessary to repeat the  
10 cleaning out of the liner and the casing a number of  
11 times with different cleaning fluids until a situation  
12 is obtained in which the last clean out is carried out  
13 with sea water. Hence, it is necessary to be able to  
14 repeatedly operate the apparatus to divert flow between  
15 the lower end and upper end of the liner a number of  
16 times. With the apparatus described above there is the  
17 disadvantage that the apparatus is designed so that  
18 each spherical ball that is dropped down the drill-  
19 string changes the direction of clean-out liquid flow  
20 either from the lower end of the liner to the upper end  
21 or from the upper end of the liner to the lower end of  
22 the liner. Hence, the number of times which this  
23 apparatus can be used to cycle fluid between the lower  
24 and upper ends of the liner is limited by the design of  
25 the device and when the spherical balls have been used  
26 or the tool is full with spherical balls and cannot be  
27 cyclically operated further, it is necessary to extract  
28 the drill-string from the borehole in order to recover  
29 the device and remove the spherical balls from the  
30 device.

31  
32 In addition, there is also the danger that the  
33 spherical balls may not properly engage with the device  
34 and the risk that the device will not operate  
35 correctly.

1 In accordance with the present invention, there is  
2 provided apparatus for circulating fluid in a borehole,  
3 the apparatus having a fluid inlet and a first fluid  
4 outlet, the first fluid outlet communicating with the  
5 fluid inlet for throughflow of fluid through the  
6 apparatus, and the apparatus including:-

7 a body member having a second fluid outlet;  
8 an isolation means movably mounted on the body  
9 member for movement between an open position in which  
10 fluid introduced into the apparatus through the fluid  
11 inlet may flow out of the second outlet, and a closed  
12 position in which fluid is substantially prevented from  
13 flowing out of the second outlet; and  
14 actuating means connected with one of the body  
15 member or the isolation means for coupling to a  
16 formation in the borehole to provide resistance to  
17 movement of the actuating means with respect to the  
18 formation, whereby movement of the other of the body  
19 member or the isolation means relative to the formation  
20 causes relative movement between the isolation means  
21 and the body member to move the isolation means between  
22 its open and closed positions.

23  
24 An advantage of the invention is that by providing an  
25 isolation means which is movable between a closed  
26 position and an open position and an actuating means  
27 which may be coupled to a formation in the borehole,  
28 circulation of fluid can be redirected by movement of  
29 one of the body member or isolation means relative to  
30 the formation. ✓

31  
32 Typically, the formation may be a shoulder portion in  
33 the borehole. Alternatively, the formation may be the  
34 bottom of the borehole, in which case the actuating  
35 means may be coupled to the formation by a string, such